Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

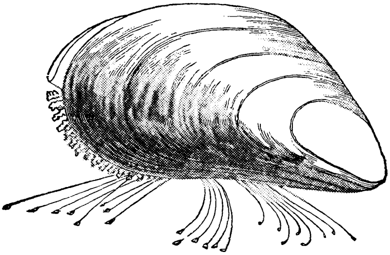
Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

within its own type, characteristics of lower forms of life; and thus do all the higher animals in their embryonic condition, pass through stages representing the lower vertebrates.

MUSSEL CLIMBING.

BY REV. S. LOCKWOOD, PH.D.



Can any one see a snail travel, and not ask mentally, "how it does it?" The method certainly is curious. A fleshy disk is protruded, and caused to project in the direction of locomotion; it is then spread out flatly, and while slightly adhering to the object over which it is passing, a contractile energy is exerted, and the little animal bearing its house is drawn onward. Thus by the repeated protrusion, expansion, and contraction of this soft organ, in due time its journey is accomplished. Because of this method of progression on a ventral disk, all those shell-fish, or properly speaking, molluscan animals, so constituted, are called by the systematists, gasteropods, a term which means ventral-footed. And in rank these gasteropods stand next to the most highly organized of the mollusca. But some of these shell-encased creatures do not travel at all. Take, for instance, the oyster, called a monomyary, because the valves are held together by a single muscle. This sedate bivalve once settled, probably never moves from that spot. But all the dimyaries, or two-muscled bivalves, well represented by the common edible mussels, possess a foot, which is not greatly unlike that of the snails. The mussel's foot, however, presents in its class, the least developed condition of this organ, for it is a spinner, rather than a walker; or, as Owen says, "it is subservient to the function of a gland, which secretes a glutinous material analogous to silk, the filaments of which are termed the byssus," which often serves for attachment to rocks. He farther says, "in most dimyary bivalves the foot is an organ of locomotion." Some of the river mussels in babyhood spin a byssus with which to moor themselves against the currents of the stream. When older grown this necessity is overcome, and the capacity just mentioned is lost. Then the adult turns its foot into a plow-share, and is dragged along in the furrow it makes in the mud. The razor-shell alternately bores downwards and propels upward, the foot doing all the work. With the foot as an elastic spring the heart-shell leaps along. But the common black mussel, *Mitylus edulis*, and its despised neighbor, the brown horse mussel, *Modiola plicatula*, who ever saw them walk? Propulsion is not always walking. The scallop with its large adductor muscle, by snapping together its light valves, thus forcibly ejecting the water within against the water without, flits through, and sometimes even skips upon its native element, like an aquatic butterfly. But no pedestrian does so in all Mollusca-dom. Why then should not these pedate bivalves, the mussels, walk as others of their own people do? "For want of brains!" says one. You are mistaken, sir. They have brains, the right kind too, and in the right place,—a real pedal nerve-mass, or ganglion; a little bilobed brain at the very base of the "understanding" itself, that is, exactly under the foot, as was fabled of a very agile dancer, that his brains were in his heels.

Now, if seeing is believing, mussels can walk. We once saw a young brown mussel, of the species *Modiola plicatula*, about five-eighths of an inch in length, turn his foot to most excellent account. We had pulled the youngster's beard off, and then had deposited him at the bottom of a deep aquarium. The water was probably but poorly aerated, hence he was evidently ill at ease, and to our astonishment he at once began travelling over the pebbly bottom, then up the glass side with the utmost facility and grace. The foot moved precisely as any univalve gasteropod would do, and with the same easy gliding motion. The movement was continued without interruption until it had reached the surface of the water, a distance of not less than ten inches, which added to the distance travelled over the bottom, was probably equal to fourteen inches. At the surface it lost no time in spinning its byssus, which it fixed to the side for a permanent abode.

For its lively colors, perhaps rather ruthlessly, we had picked this little fellow out of a large family cluster, snugly packed in a hole in one of the piles of the dock. It was a large group of all sizes, literally bound together by the silken cords of — attachment shall we say?

A fellow captive was a full grown, black, edible mussel, torn from its anchorage, a stone near by, at low tide. We afterwards found ensconced in this black shell, an amount of intelligence, which filled us with astonishment. If his youthful fellow prisoner could beat him at walking, he was about to accomplish the feat of climbing to the same position by means of a species of engineering of a very high order.

In order the better to understand this singular feat, let us introduce it by the narration of some spider tactics we once witnessed. The insect had captured a large beetle, but could not get it to its web, and seemed indisposed to prey upon it away from its den. It had dragged the prey under the web, which was about two feet above. It ran up to a point close by its web; there it attached a thread, by which it speedily descended, and then attached the other end to its booty. Again it ascended, affixed another thread, then descended and affixed to the prey as before. Each thread, in sailor phrase, was made taut. After a good many threads had been in this manner attached, each being stretched tightly, and each pulling a little, the weight was seen to ascend a small fraction of an inch. Again the threads were increased, and again the weight ascended a little more, until at last, after incredible labor, perseverance and skill, the little engineer had the satisfaction of success; for its well earned booty, with one final, tiny jerk "brought up" at the desired spot. The explanation of all this is simple. Suppose we take a cord of the material known by the ladies under the name elastic, and attach it to an ounce weight. If but very moderately stretched it would certainly pull at least a grain. Supposing it to do that, a second one would pull with equal force, and it would be but a simple estimate to determine how many threads would be required to raise the entire weight. But enough of this. Now for the mussel.

Placed at the bottom of the aquarium, where it had been for a couple of days, it had succeeded in wiggling itself up to one of the glass sides of the tank. This accomplished it protruded its large foot, stretching it up as high on the glass as it could reach, this organ seemingly adhering very tightly. A little hole opened near the extreme forward end of the foot. This tiny hole was really the extremity of a folded or closed groove. Out of this a drop of white gluten, or mucus, not larger than the head of a pin, was exuded, and pressed against the glass. There was then a slight withdrawing of the foot, simultaneously with an unfolding, or opening of the groove, which contained, as if moulded there, the already completed delicate thread. This done, the partly contracted foot (not drawn into its shell at all, be it understood) was again extended, this time a little higher than before. The groove, or spinneret, was again closed, except the little opening on the surface of the foot, whence another little drop of mucus appeared, which also was pressed against the glass. Again the foot was withdrawn a little, the lips of the groove unfolded, and the moulded thread set free. This gave thread number two. Each was evidently set at a considerable tension. And in this wise, thread after thread was formed and set. I regret that I did not record the exact number, but am sure that it was about twelve or sixteen, and the time occupied was between two and three hours, when lo! up went the mussel, about three-eighths of an inch high. Yes, he was drawn up by his own cords. He was literally lifted from *terra firma.* Not at all suspecting what was to follow I mentally exclaimed. "This little fellow knows the ropes."

There was next a period of rest. Whether it was due to exhaustion of material, and was meant to allow the secreting gland time to evolve a fresh supply or not, I cannot affirm; but must say that such was my belief, for after an hour or so it set to work again, precisely as before, attaching a new cluster of threads. This cluster was set about five-eighths of an inch higher than the previous one. When this new group of filaments was finished, the same result followed, another lift of a fraction of an inch, but not quite so high as the first. I now suspected its motive—the animal was actually in this singular manner attempting to reach the surface. It wanted to take an airing, and was really in a fair way to bring it about.

While setting its third cluster of threads, I foresaw a serious difficulty in the way, and one against which the spider never has to contend. It was this: after the third lift had been achieved the threads which had accomplished the first lift had changed direction; that is, the ends of the threads, which had pointed downward when pulling up the mussel, were now pointing upward, and were actually pulling it down. Of course the lowermost thread, or threads, would exert the most retrograde traction. Thought I, "Sir Musselman, you will have to exercise your wits now." I rejoice to say that the ingenious little engineer was complete master of the situation. The difficulty was overcome in this way —as each lowest thread became taut in an adverse direction, it was snapped off at the end attached to the animal. This, as I think, was done by two processes; the one by softening that end of the thread by the animal's own juices, purposely applied, as the pupa in the cocoon moistens its silk envelope, when wishing to soften the fibres, so that it can break a hole through which the imago may emerge; the other by a moderate upward pulling, thus breaking the filament at its weakest point.

The next day our little engineer had accomplished the wonderful feat of climbing to the surface by ropes, fabricated during the ascent. Without delay it moored itself securely by a cluster of silken lines at the boundary where sky and water met, and was there allowed to enjoy the airing it had so deservingly won. Bravo! my little Mussel-man! No acrobat can beat thee on the ropes!

And what are we to say to all this? Blind instinct, forsooth! Who believes it? The wise men of the ages have written as the tradition of the elders—"byssus-bound," of our Mytilus. But it can make of its bonds, mooring lines of safety against the storm, and with consummate skill can build a silken stair-way into its own wished for elysium of delight. It is some three years since the writer witnessed the facts here recorded, and to this day, the sight of a mussel inspires him with profound reflection on the ways of Him who made these creeping things of the sea.

NOTE.—It has seemed to the writer, that in the perfection of movement shown by the *Modiola plicatula*, as given above, a high stage of foot development is indicated, such as would hint at a grade out-ranking *Mytilus edulis*. The figure inserted is that of *M. edulis*; but the process of climbing is the same.—S. L.